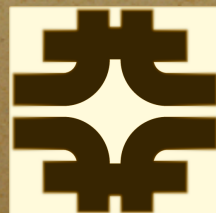


The first SSR1-ez

The manufacturing of the first SSR1 at Zanon

G. Lanfranco

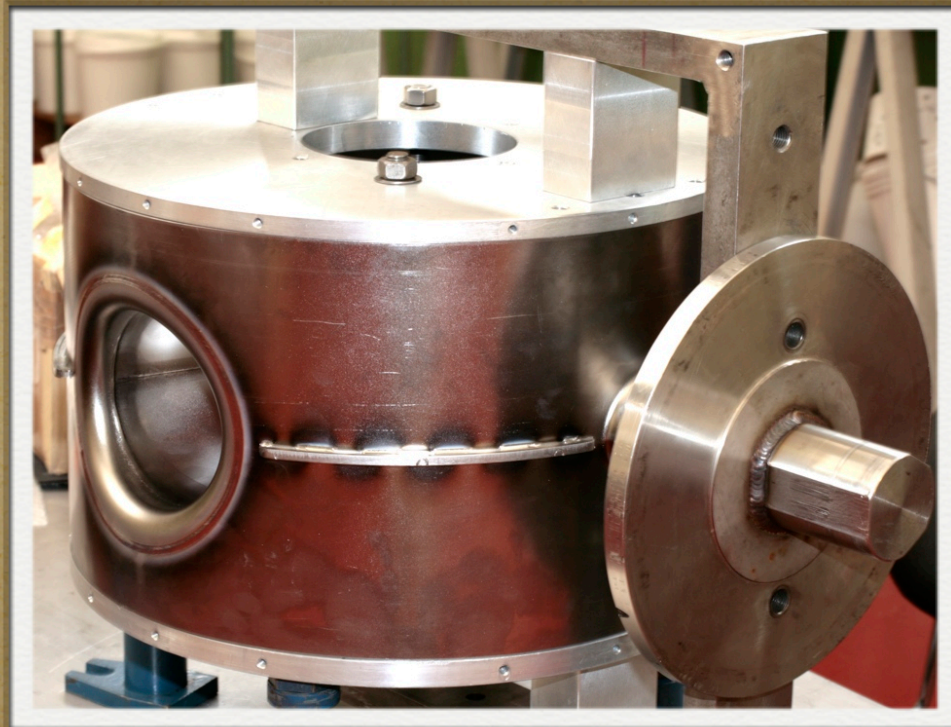
TD - SRF Development



Outline

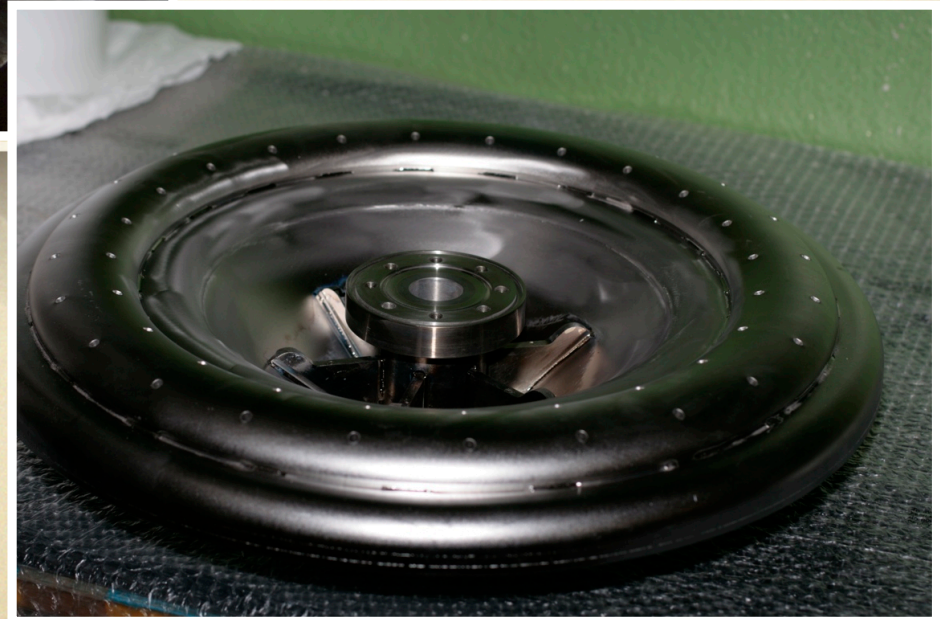
- The “-ez” stands for Ettore Zanon (the other SSR1 will be “-rk”)
- A photographic tour of the main stages of the SSR1-ez production and some considerations for mass production
- The cavity final tuning and the SSR1 status





Cavity manufacturing

The end wall finally in one piece



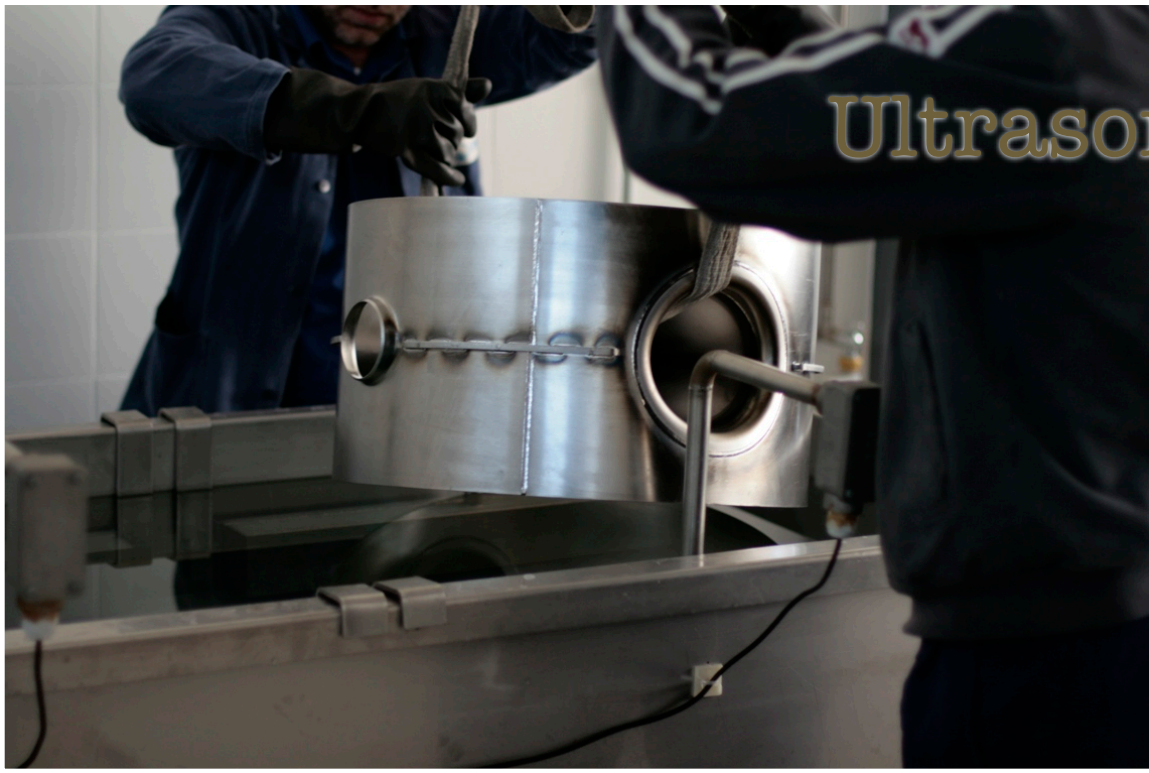
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Very smooth and uniform weld beads



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Ultrasonic cleaning



G. Lanfranco

HF cleaning



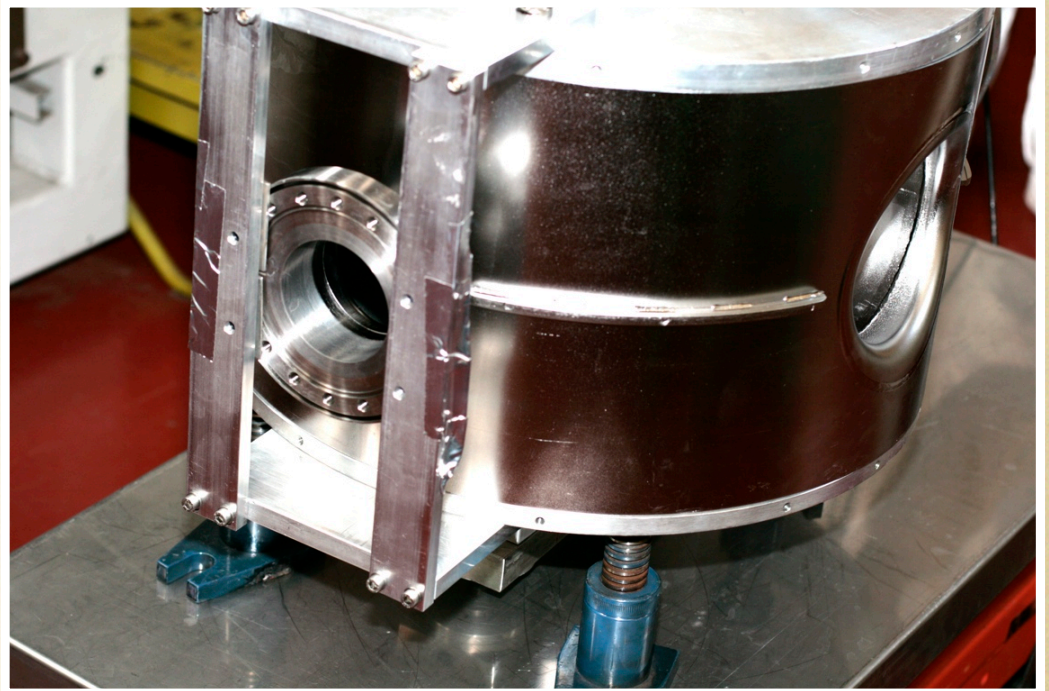
Ultra pure water
cleaning

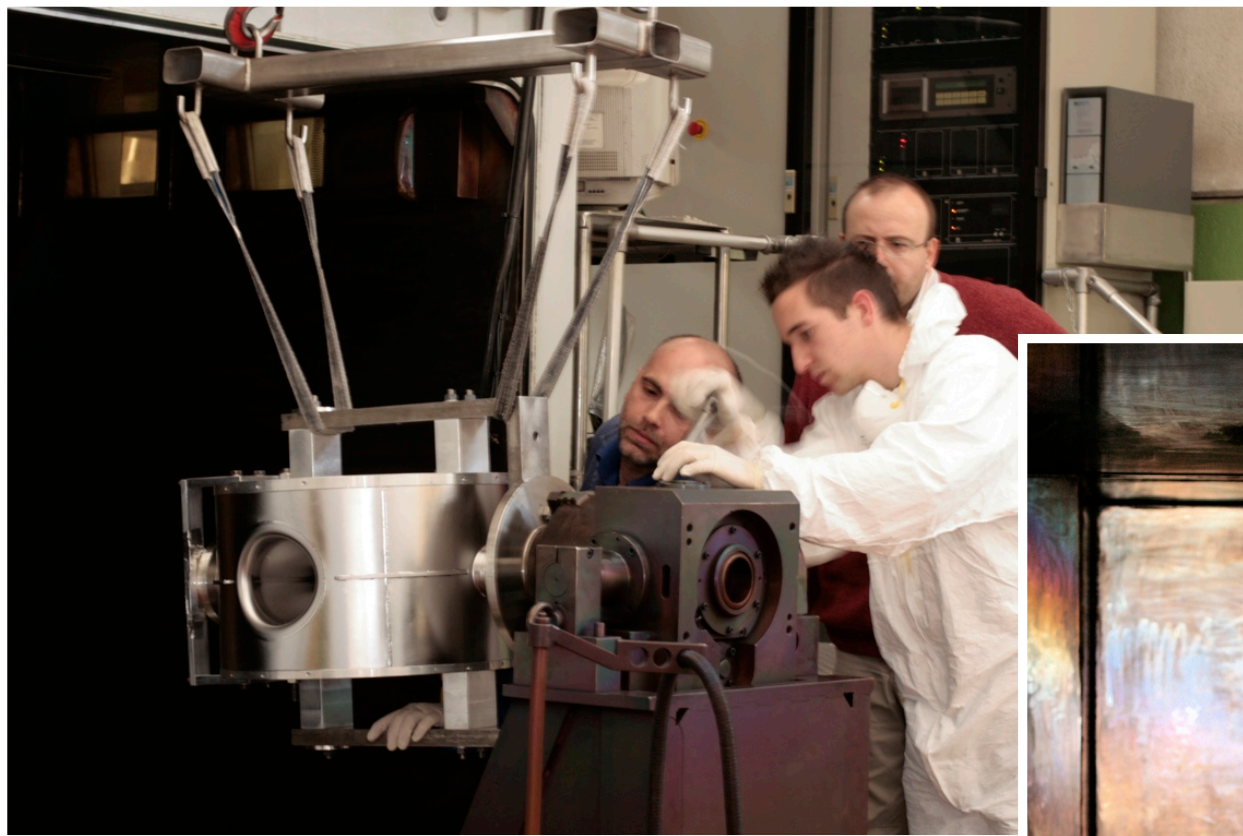


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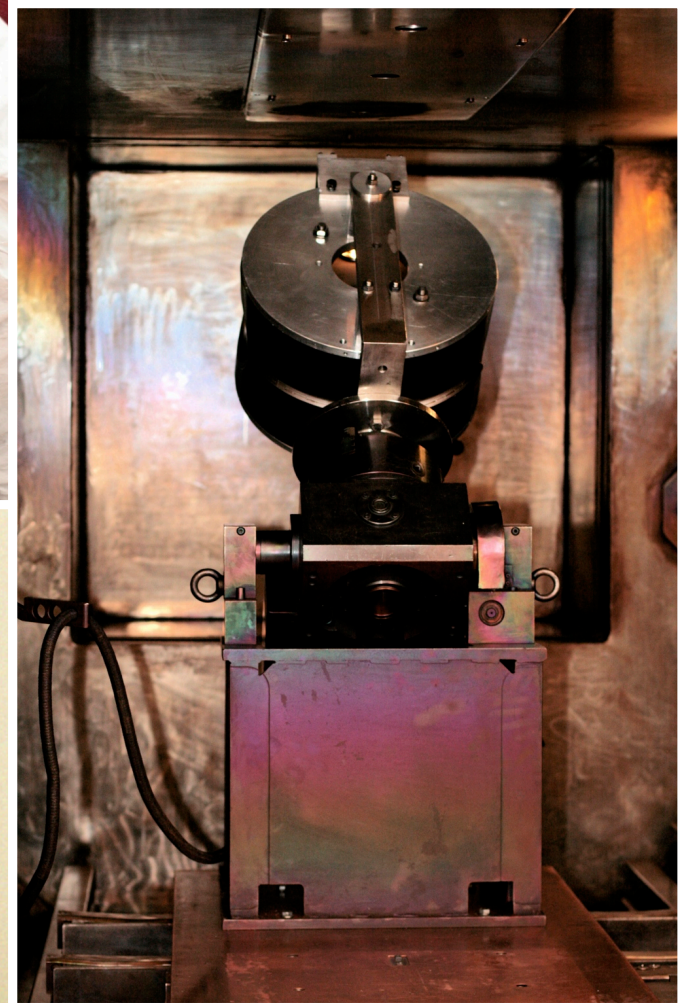


The power coupler ports
are ready for EB welding...





... and are loaded onto the
EB welding machine



Finally the shell with spoke assembly is ready!



Some lessons learnt

The thoughts below are not intended for the current SSR1 prototype production but for for SSR mass production.

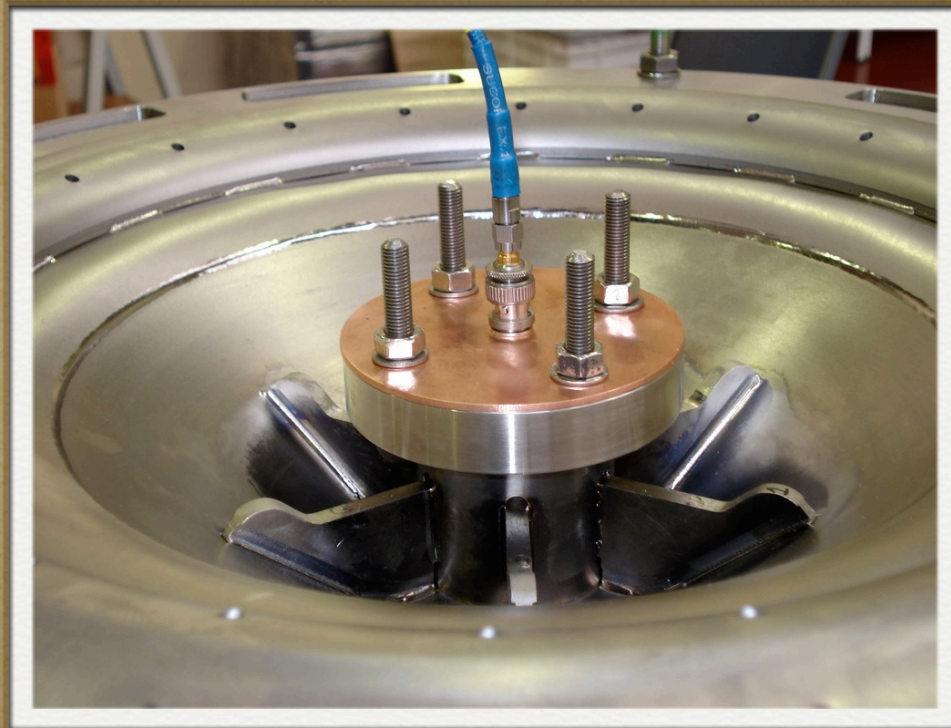
- Given the conical shape and many welds that tend to distort the formed sheet, it is no surprise the end wall definitely must be formed in one piece. This is already what Roark is doing
- To simplify the end wall rib welding, a continuous conical rib might be a solution for the SSR1 final production. It is necessary of course to investigate if it provides the same stiffness.



Some lessons learnt

- The power coupler transition is very expensive and the thick design does not facilitate the brazing. It is worth analyzing a design with a rolled and welded pipe that will be butt welded onto the cavity shell.
- With a SS He vessel von Mises stress is high. Adopting a Ti vessel might help not only reducing the stress and the T-induced displacements, but would eliminate the brazing (NbTi flanges). Clear downsize: cost (at least~ 50 \$/lb and price rising). Bob and I are working on it and should converge soon.

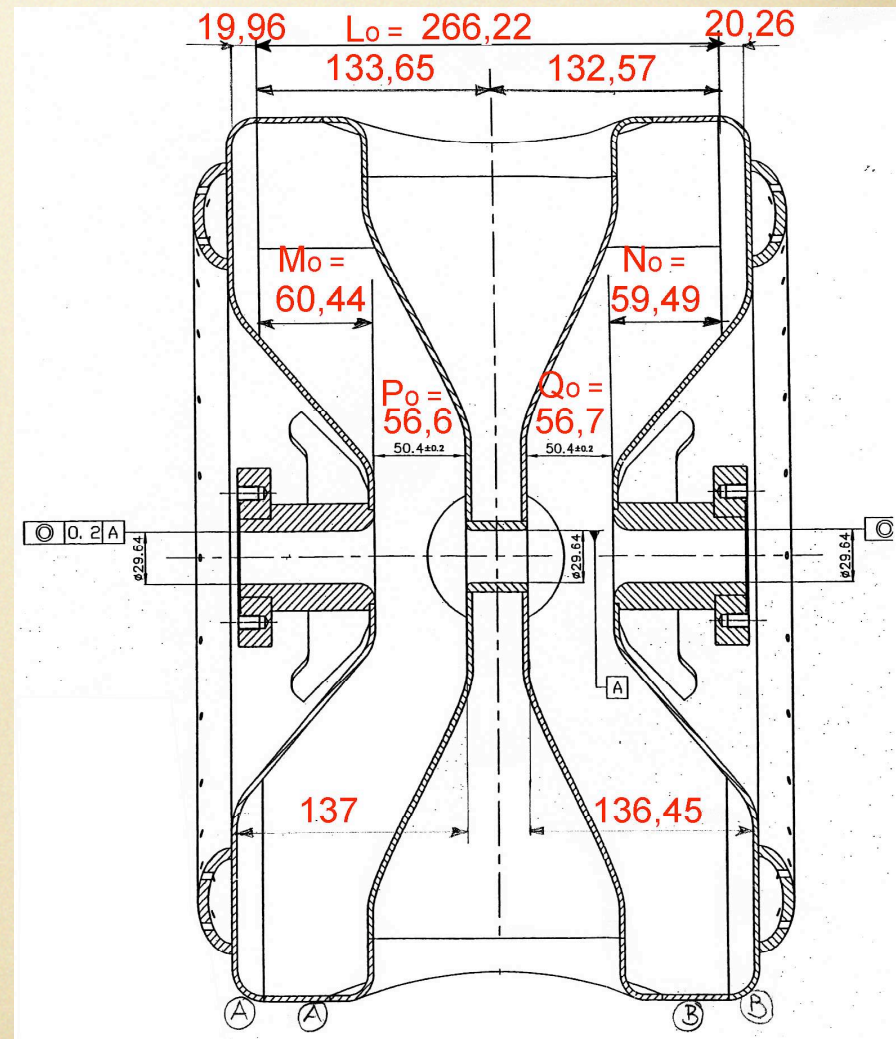




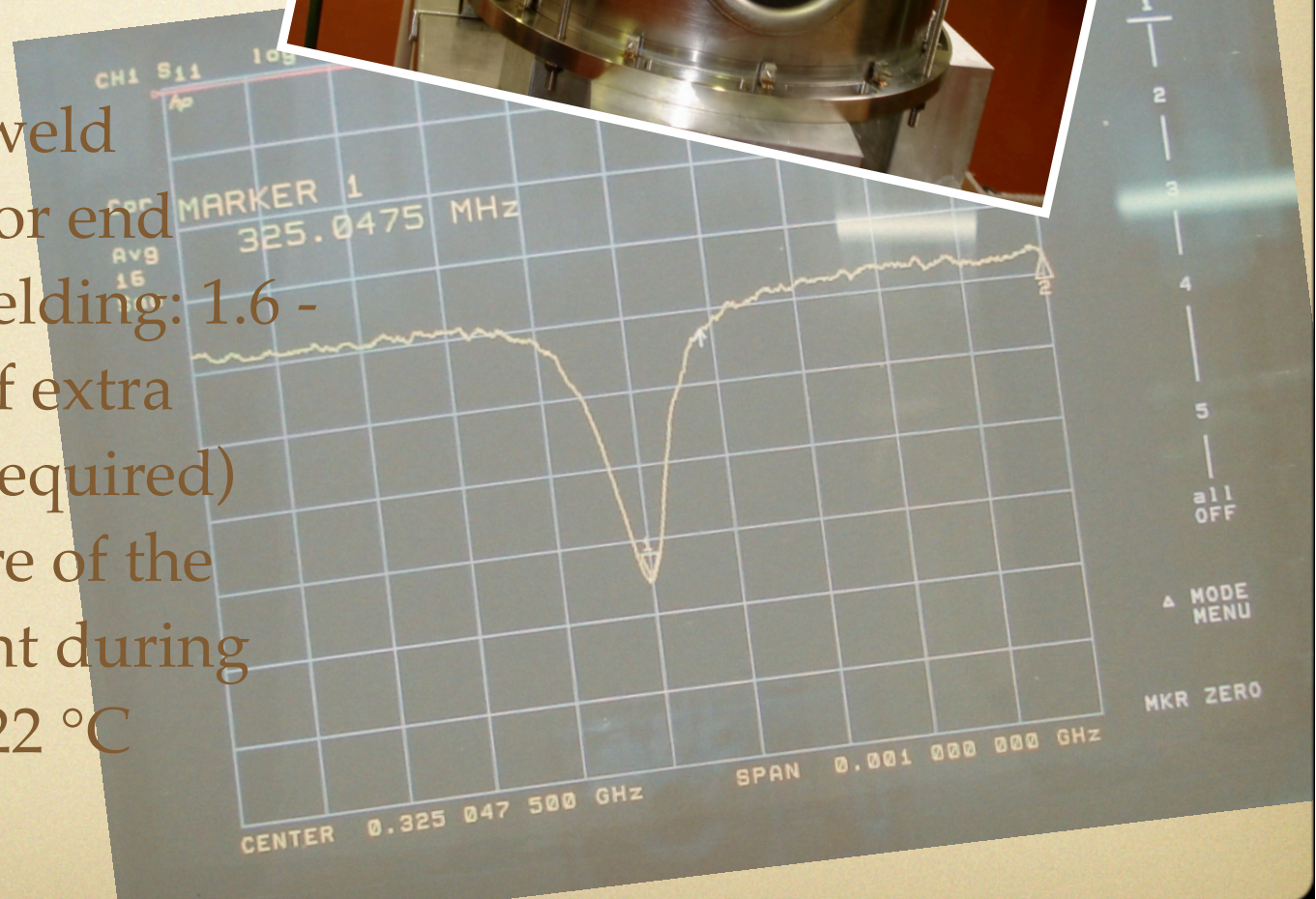
Cavity Tuning

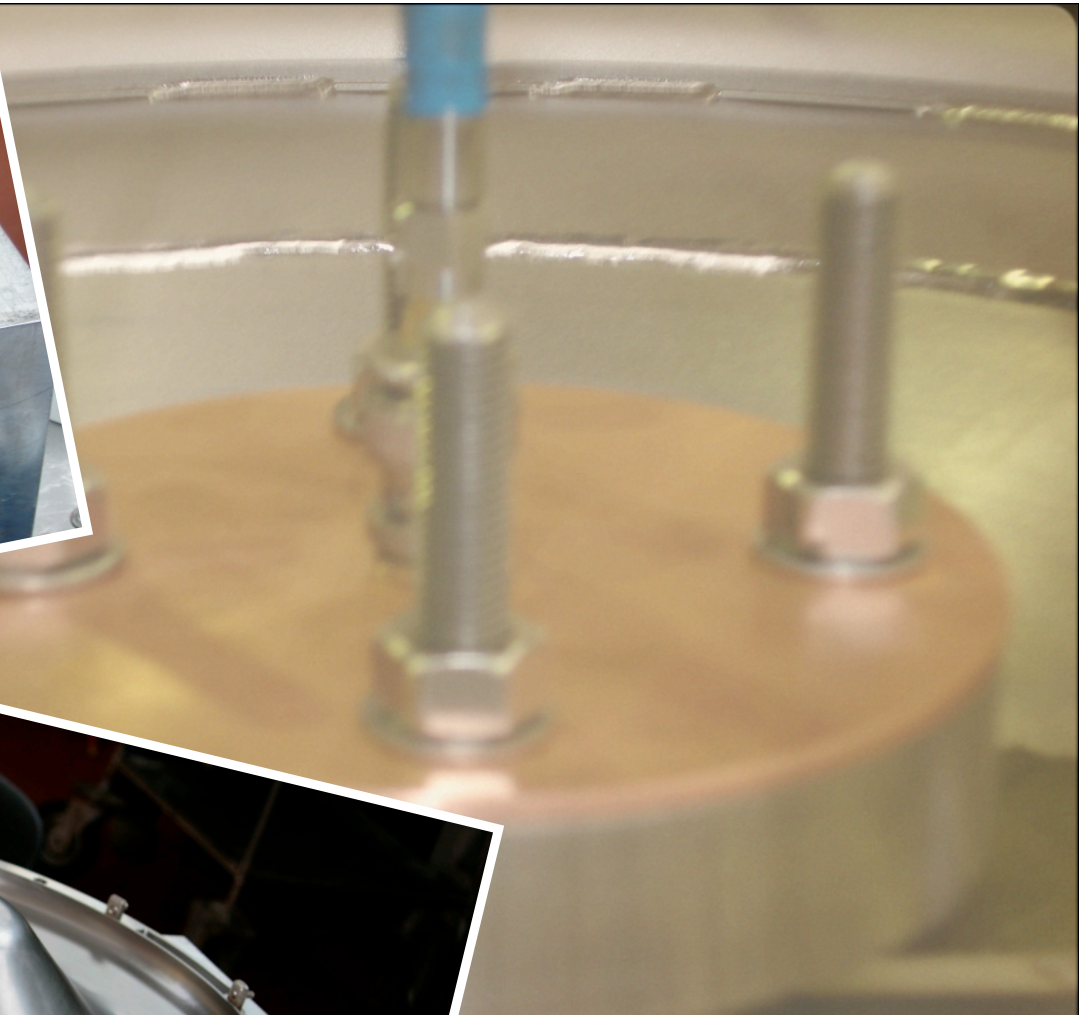
SSR1 dimensions before tuning

theoretical L_o	256.17
measured L_o	266.22 = 133.65 + 132.57
Available metal overage	10.05
L_o measured before last cut	258.80 = 129.75 + 129.05



- Target frequency of warm cavity before welding (weld shrinkage not included): **324,535 MHz**
- Estimated weld shrinkage for end walls EB welding: 1.6 - 2.2 mm (> if extra weld pass required)
- Temperature of the environment during tuning: 21-22 °C

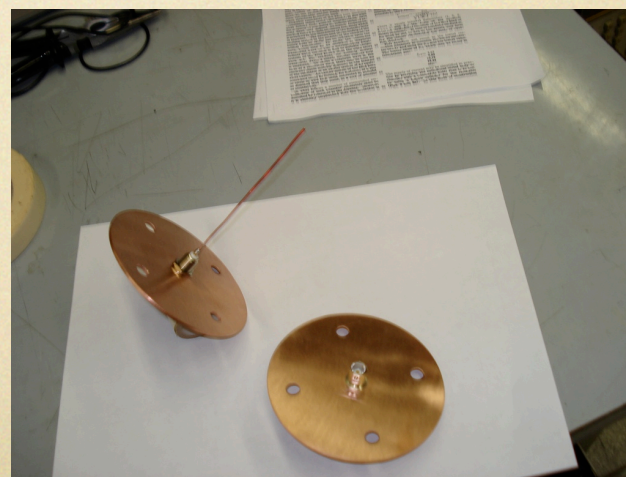
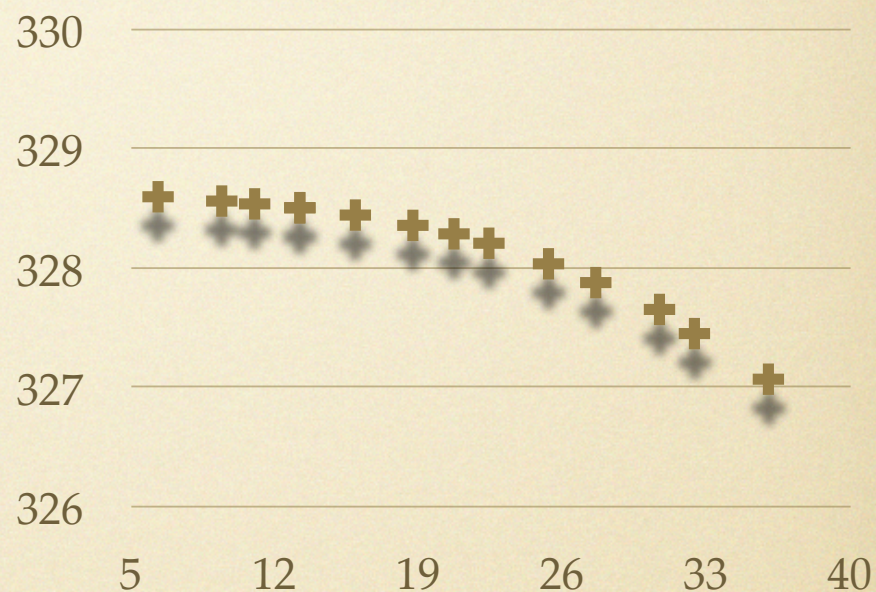




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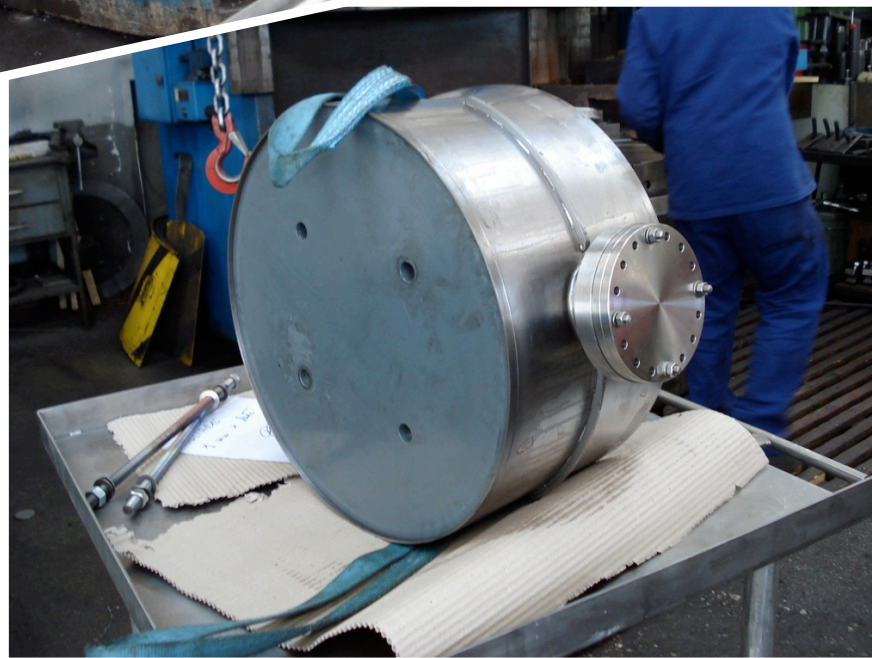
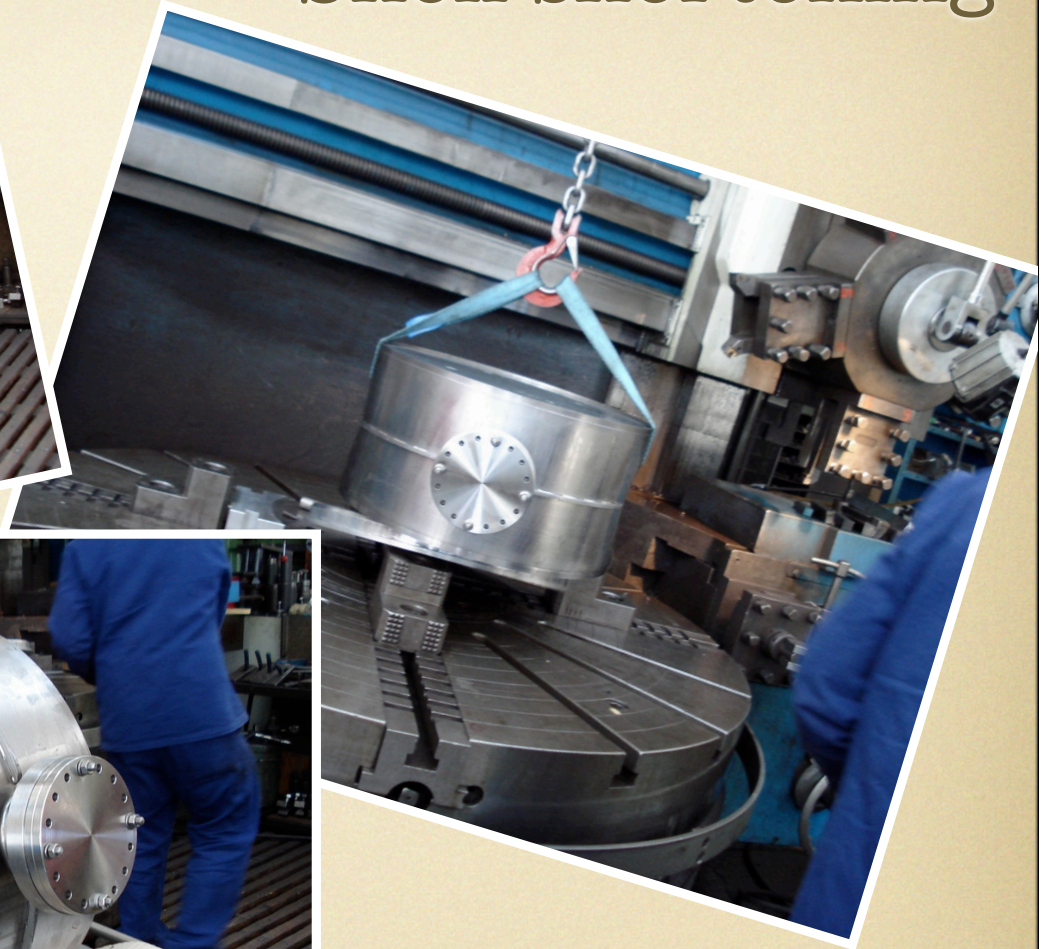
Antenna “tuning”

Penetration [mm]	Frequency [MHz]
36	327.07625
32.4	327.45875
30.7	327.66125
27.6	327.88625
25.3	328.04375
22.4	328.21625
20.7	328.295
18.7	328.36625
15.9	328.4525
13.2	328.5125
13.2	328.515
11	328.54625
9.4	328.57
6.3	328.606



G. Lanfranco

Shell shortening



G. Lanfranco

Dimensional and Frequency measurements

Measure N°	L_0 [mm]	F [MHz]	ΔL [mm]	ΔL [mm] expected	ΔF [kHz]	$\Delta F/\text{mm}/$ side [kHz] (**)	Q_0
initial	266,22	328,606	-	-	-	-	3670
#1	264,4	327,961	1,82	2	645	708.8	4362
#2	260,60	326,625	3,8	4	1336	703.2	4490
#3	258,80	326,0275	1,80	2	597.5	663.9	5412
final value before weld shrinkage	256,13	325,0475	2,67	0,8+1,7 (*)	980	734.1	4025

(*) a correction was necessary to bring the two iris gaps to be comparable

(**) theoretical $\Delta F = 735 \text{ kHz/mm/side}$



SSR1 dimensions after tuning

L _o [mm]			
Side A	Side B	nominal	total
128.70	127.43	256.17 (*)	256.13

Iris gap [mm]		
Side A	Side B	nominal
51.65	51.56	51.4 (**)

1 mm per side of weld shrinkage is assumed

(*) The 1 mm end wall weld shrinkage is assumed equally divided between the end wall and the shell. This value hence includes 0.5 mm weld shrinkage.

(**) The 1 mm expected weld shrinkage is being considered



Some projections on the warm final frequency (after end walls weld shrinkage)

- Actual cavity sensitivity =
367.1 kHz /mm
- Actual F =
325.05 MHz
- Target F =
324.535 MHz
- Avg. expected shrinkage ~2mm

Total Weld Shrinkage [mm]	Projected frequency F_{Final} [MHz]	$\Delta F = F_{\text{TARGET}} - F_{\text{Final}}$
2.40	324.1666	0.3684
2.30	324.2033	0.3317
2.20	324.2400	0.2950
2.10	324.2767	0.2583
2.00	324.3134	0.2216
1.90	324.3501	0.1849
1.80	324.3868	0.1482
1.70	324.4235	0.1115
1.60	324.4602	0.0748
1.50	324.4969	0.0381
1.40	324.5336	0.0014



Summary

- The cavity warm frequency before welding the end walls is 325.05 MHz. The final warm value, depending on the weld shrinkage, is expected to be around 324.3 MHz vs a theoretical target value of 324.5 MHz.
- The SSR1-ez is about to be completed. The three main sub assemblies are currently undergoing final cleaning. Next week the end walls are scheduled for EB welding (most delicate operation of all!). The week of April 23rd the cavity should be in one piece and ready for leak check. By the end of the month the SSR1 should ship.

